The prevalence of foot problems in an Indian population

Michael Harrison-Blount, Farina Hashmi, Christopher Nester, Anita E Williams

There is little known about the general incidence and prevalence of foot problems in India. Sociocultural practices and the rising prevalence of diabetes put foot health at risk. The aim of this study was to provide data on the prevalence of predisposing factors for the development of foot problems, the range and nature of foot health problems and the epidemiology of foot complications, particularly in association with diabetes. Data on foot health conditions were collected using a systematically developed foot health assessment tool (the Salford Indian Foot health assessment Tool). Results showed a range of foot problems exist in this locality, complicated by late presentation due to multiple factors, including the growing burden of diabetes.

Little is known about the general incidence and prevalence of foot problems in India, despite the high incidence of conditions such as leprosy and diabetes that are known to affect the feet, often with serious consequences. India has the highest number of people affected by leprosy in the world, accounting for 60% of new cases (Chandler et al, 2015), and the prevalence of peripheral arterial disease in Southern India has been estimated at 3.2% (Premalatha, 2000). India also leads the world in terms of the amount of people with diabetes, with numbers estimated to be over 100 million by the year 2030 (International Diabetes Federation [IDF], 2013). There is also a proportionate increase globally in diabetes-related complications resulting in increased morbidity, mortality and health expenditure (American Diabetes Association, 2012).

Of those with diabetes, 20–40% will have peripheral neuropathy (PN) and peripheral vascular disease (PVD) (Clayton, 2009; NICE, 2015). These two complications, combined with foot deformities, minor foot trauma, differences in sociocultural practices and lack of knowledge of foot care, all contribute to foot complications, such as ulceration (Shankhdhar et al, 2008). Poverty and illiteracy lead to improper footwear use. Sociocultural practices, such as barefoot walking, removal of footwear for religious practices, not wearing socks (especially in females) and the late presentation of foot lesions have all been found to contribute to injury and the development of hyperkeratosis, nail problems and heel fissures in the Indian population (Chandalia, 2008; Shankhdhar et al, 2008).

The prevalence of diabetic foot ulcers is reported to be between 3.6% and 10.4% (Pendsey, 2004; Mehra et al, 2008), with the prevalence increasing with age (Campbell, 2006) and resulting in 40,000 leg amputations annually. It has been suggested that in most cases, 75%–85% of diabetic foot ulcers and amputations are potentially preventable with early identification of minor lesions (IDF, 2014). Due to the scale of diabetes and the impact of diabetes on the feet it is reasonable that services providing foot care interventions should focus on this patient group. However, there are challenges in relation to prevention of foot ulceration, whatever the cause, with little written in relation to protocols and guidelines for managing foot health in India (Mohan et al, 2013).

It is clear from Western practices that at least for those with diabetes, the reduction of the potential consequences of ulceration and amputation can be achieved through screening for risk factors for foot complications, such as skin and nail conditions,

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Article points

1. Little is known about the general incidence and prevalence of foot problems in India.
2. There is a proportionate increase in diabetes foot related complications leading to ulceration and amputation.
3. Awareness and early identification of foot problems can reduce the potential devastating consequences of diabetes related complications.

Key words

- Foot health
- Patient knowledge
- Prevalence

Authors

Michael Harrison-Blount is Lecturer in Podiatry, School of Health Sciences, University of Salford; Farina Hashmi is Lecturer in Podiatry, School of Health Sciences, University of Salford; Christopher J Nester is Research Programme Leader, School of Health Sciences, University of Salford; Anita E Williams is Reader, School of Health Sciences, University of Salford

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Table 1. Patient demographics.

Participant age	Age breakdown	Gender	Participant employment
18–24	6 (2.7%)	male: 72 (32.1%)	Professional roles: 7 (3.1%)
25–34	29 (12.9%)	female: 138 (61.6%)	Skilled roles: 14 (6.3%)
35–44	36 (16.1%)	Not recorded: 14 (6.25%)	Unskilled roles: 3 (1.3%)
45–54	44 (19.6%)		Full-time education: 6 (2.7%)
55–64	60 (26.8%)		Unemployed or retired: 194 (86.6%)
65–74	19 (8.48%)		
75+	2 (0.9%)		
Not recorded	29 (12.9%)		

Page points

1. 224 patients with foot problems were recruited to the study over a 12-month period.
2. The context specific foot health assessment tool (SIFT) had been previously developed in this location by the clinicians who would use it to collect the data.
3. Clinicians gathered demographic data and performed examinations and assessments to identify all potential foot health pathologies and not just those related to diabetes.

neuropathy and deformity (Bower and Hobbs, 2009). Few studies in India have assessed the impact of early interventions for foot complications in patients both with and without diabetes. However, those studies that have identified the need for systematic foot examination on a regular basis or have implemented prevention and effective management at the initial stages of diabetes, demonstrated positive reductions in amputations, reduced morbidity and have been cost-effective (Apelqvist et al 1999; Vijay et al, 2000; Viswanathan, 2005; Bower and Hobbs, 2009).

The development of screening in order to achieve effective and timely management strategies has already been achieved through the implementation of a locally defined, context-specific assessment tool to aid identification of foot problems (Harrison-Blount et al 2014; Harrison-Blount et al 2015). The Salford Indian Foot health assessment Tool (SIFT) (Harrison-Blount et al 2015), is the first systematically developed, context-specific assessment tool for the identification of foot problems. Further, the information gathered from SIFT can be used to identify areas for service improvement, such as the implementation of appropriate and timely management for individual patients presenting with foot health problems. The authors aimed to provide data on the prevalence of predisposing factors for the development of foot problems, the range and nature of foot health problems, and the epidemiology of foot complications particularly in association with diabetes.

Methods

Ethical approval for the study was obtained from the University of Salford Research, Innovation and Academic Engagement Ethical Approval Panel (Approval number HSCR12-22) University of Salford and the hospital governance team at the study location site in India.

This was a cross-sectional, population-based study in a single centre where 224 participants with any foot problems were recruited. Data were collected over a 12-month period from participants attending the newly opened outpatient foot clinic at a University hospital in Chennai, India. No patient declined to take part in the study. A foot examination formed part of the consultation as the patients were attending the clinic with a foot-related issue and, therefore, consent was implied for this to take place. However, specific consent was obtained for the data to be used for the purposes of this publication. Patients were asked to complete a consent to participate form as part of their assessment. Any subjects attending the clinic under the age of 18 were excluded from the study; all other patients were included.

Data collection

The tool used to gather the data was SIFT (Harrison-Blount et al, 2015). It has 13 sections of risk factors that align with Western guidelines (IDF 2014; NICE, 2015) and practice, but were developed to be specific to the local need, including a range of assessments for all potential foot pathologies and not just those related to diabetes (Harrison-Blount et al, 2014; 2015). Subsections include the relevant tests, assessment methods and visual checks used to identify foot pathologies.

Those clinicians carrying out the clinical assessments and recording the data on the SIFT had been part of the 'action research' process that had developed it and so had received training in how to use it in clinical practice. As the tool had been developed within this healthcare system with the context of its use taken into consideration during development, this added to the validity of the data that were collected.

In order to collect data on the prevalence of predisposing factors for the development of foot

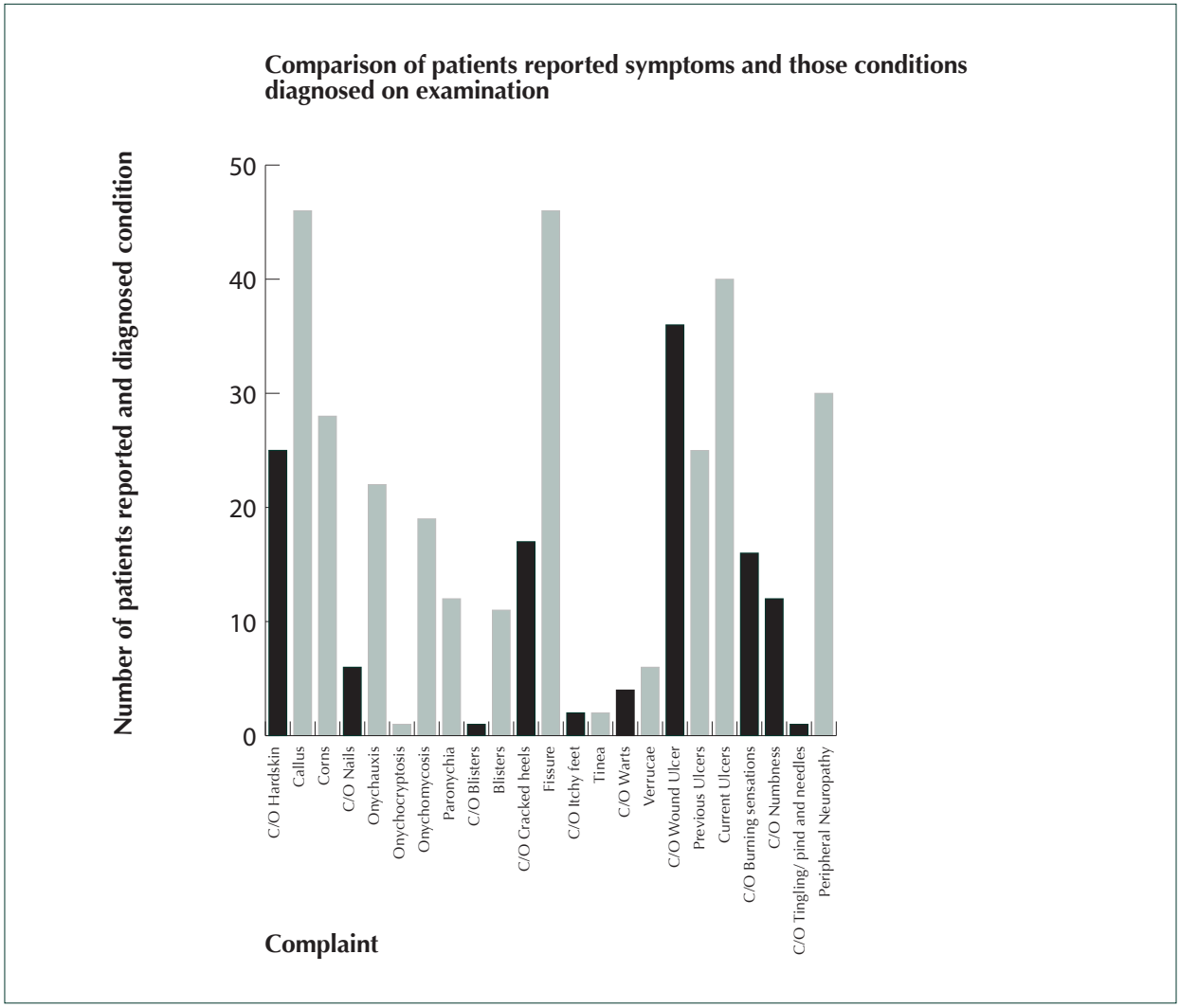

Figure 1. Comparison between the conditions patients were complaining of and the diagnosed conditions following examination.

problems, the clinicians gathered various demographic information; tobacco use; alcohol use; footwear practices; presenting foot complaints; medical and surgical history; medication; and treatment to date. They then carried out physical examinations, such as palpation of foot pulses to establish any evidence of vascular disease, and monofilament and tuning fork tests to establish whether neuropathy was present. The monofilament testing also included recording hypopigmented skin lesions associated with leprosy.

In order to collect data on the range and nature of foot health problems, clinicians then examined patients' feet to make a clinical diagnosis of foot disease. Finally, clinicians recorded the reasons that patients had attended the foot clinic and the routes that they had taken to access treatment. All data were inputted and organised into Microsoft Excel and analysed using SPSS statistical package version 20.

Results

Of the 224 participants, 138 (61.6%) were female and 72 (32.1%) were male, while 14 participants failed to have their gender recorded at assessment. Demographic characteristics of the population are shown in *Table 1* (and additional file 1). The mean age of the population was 42 years (±20.69) with the highest percentage of participants within the 55–64 years age bracket (26.8%), and the total age range was from 19–88 years. A further 29 (12.9%) participants did not know their age or it had not been recorded by the clinician. A total of 194 (86.6%) participants were recorded as being unemployed, and 95 (42.4%)

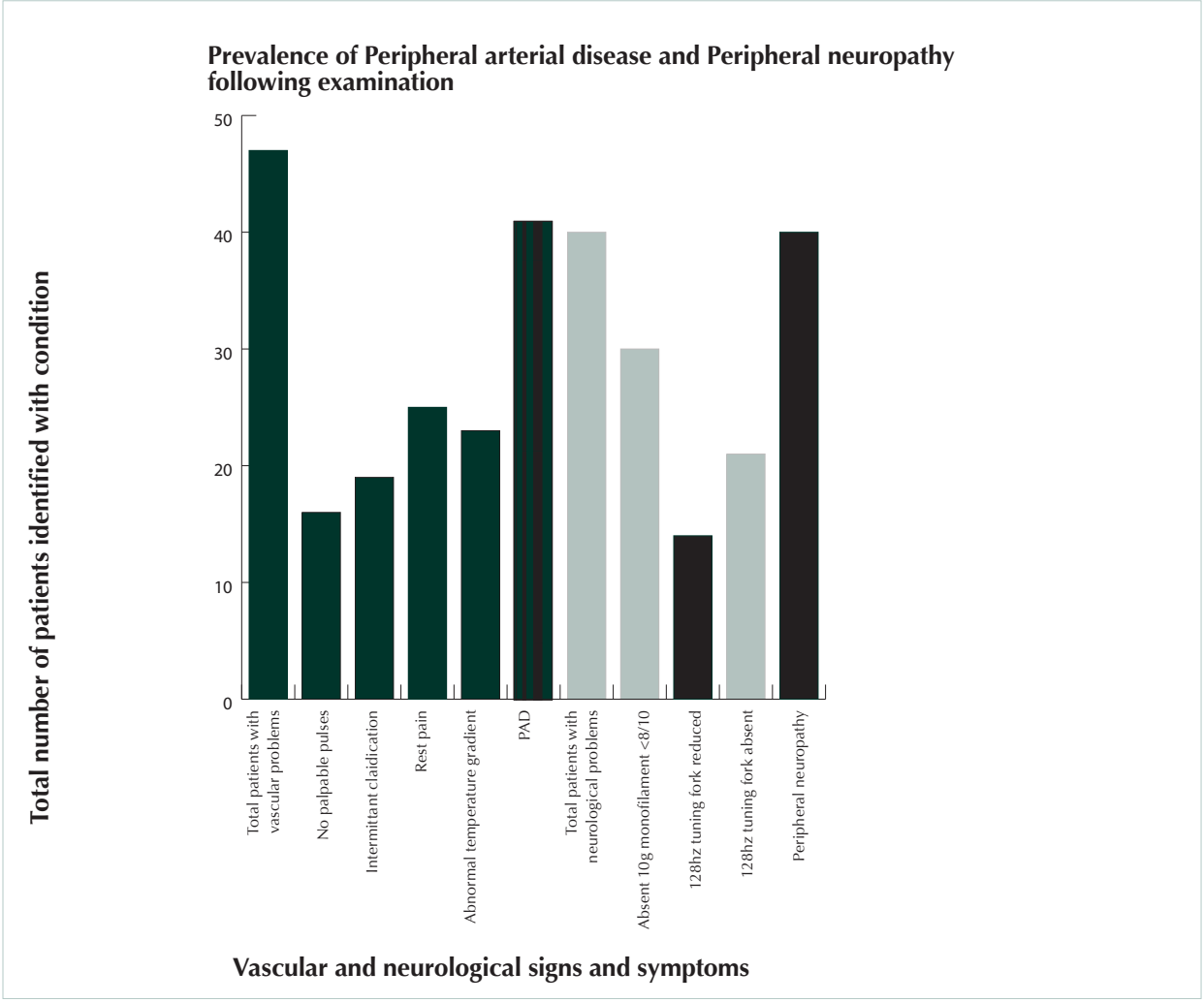

Figure 2. Prevalence of peripheral arterial disease (PAD) and peripheral neuropathy (PN) following physical examination of the patient.

were housewives. The remainder of the participants were in full-time education or employed in a variety of professional, skilled and unskilled jobs.

Figure 1 shows a comparison between the conditions that the participants were complaining of and the diagnosis of these after the clinical examination. The most common complaint was a painful heel (n=42; 18%), followed by painful feet (n=39; 7.4%) and ulceration (n=36; 16.1%). Minor lesions such as corns and callus (n=25; 11.2%), nail problems (n=6; 2.7%) and fissures (n=16; 7.1%) were under-reported by participants. The least common complaint was heel fissures with 16 reported, though 76 were diagnosed on examination. Reported pain in the toes and ankles and the presence of swelling was less common overall. There was little difference between gender, except more men complained of painful feet 16 (22.2%) compared with women who complained of heel pain (n=31; 22.5%). Of eight participants (3.6%) who were unaware of problems, seven were diagnosed with single or multiple foot problems including skin and nail problems (n= 7), active ulceration (n=2) and peripheral neuropathy (n=3). Thirty-four (15.2%) participants complained of more than a single problem with a range of further foot problems being diagnosed including digital deformities (n=22; 9.8%), Charcot neuroarthropathy (n=3; 1.3%), previous amputations (n=9; 4%) and a fracture.

Figure 2 shows the results of the vascular and neurological assessments that led to a diagnosis of PAD and/or PN. None of the participants had complained of vascular symptoms as a reason for attending the foot clinic. A total of 47 (21%)

participants were diagnosed with vascular issues following examination and referred for further vascular investigation, with 41 (87%) found to have peripheral arterial disease, and 29 (62%) having had a previous diagnosis of diabetes. Forty (18%) participants were found to have neurological deficit with 30 (13.4%) of the total number of participants reporting neurological symptoms such as burning, numbness and tingling, as one of the reasons for attending the clinic. Of those 40 participants with neurological issues, 30 (75%) were diagnosed with PN and 23 (77%) also had a previous diagnosis of diabetes.

This study showed that 93 (42%) participants were suffering with diabetes. On examination, (n=29; 31%) of these were diagnosed with PAD and (n=23; 25%) with PN. Participants with diabetes also presented with foot health issues known to be risk factors for ulceration, including fissures (n=29; 31%) and corns and/or callus (n=21; 23%). Furthermore, (n=30; 32%) had a current diabetic foot ulcer and, of these, 12 (40%) had a combination of PN and PAD, and four participants were additionally identified as having foot deformity.

In those participants without diabetes (n=131; 58%), ulceration was found in 10 participants. On examination, in the non-diabetic group the number of participants diagnosed with neuropathy (n=7; 5%) and PAD (n=12; 9%) was significantly lower than those participants with diabetes. The number of diagnosed skin lesions, however, was comparable with the diabetes group, fissures (n=41; 31%), corns and/or callus (n=32; 24%).

Data on footwear practices had not been recorded for 17 (8%) of the participants. The most common footwear practice overall was to only wear shoes outdoors (n=177; 79%) and to be barefoot at home. Other practices included always wearing footwear (n=16; 7%), indoors only (n=10; 4%) and never wearing footwear (n=4; 2%). Footwear types included chappels, open backed sandals, slippers and flip flops with and without toe posts. Those with professional roles reported wearing a closed shoe at work and sandals in the house. Three participants with unskilled employment reported working bare foot. Little difference existed in footwear practices between the groups of participants with and without diabetes.

In relation to risk factors for the development of limb- and life-threatening foot problems, the authors have identified that age, low socioeconomic group, socio-cultural practice in relation to footwear, poor knowledge about feet and foot care (particularly of minor lesions) and, hence, access to professional foot care is delayed until visible, symptomatic and/or critical problems are present. These factors, together with what we know about diabetes being under diagnosed, are leading to a major problem with foot health in this locality. If the data collected at this single site bear any relation to a regional or national picture then there is a potential 'epidemic' in India that needs halting.

Discussion

There is a dearth of epidemiologic data on the prevalence of foot problems worldwide and, specifically, data on the prevalence of foot problems and diabetes-related foot problems in India is scarce (Mohan et al 2013). Where studies have focused on foot health, they have often focused on the population suffering with diabetes alone (Viswanathan and Rao, 2013; Jyothylekshmy et al, 2015; Mahakalkar et al, 2015). This study is the first investigation into the prevalence of all types of foot disease in a location in India. Furthermore, the authors used a novel, systematic and region-sensitive approach to foot health assessment. However, perhaps the most alarming outcome of the data was the number of patients presenting too late with ulceration. This, as seen in other developing countries, was associated, with single or combinations of risk factors, such as PN, PAD, deformity and minor lesions, which commonly result in amputation (Morbach et al 2004; Ramachandran 2004; Viswanathan and Rao, 2013; Mahakalkar et al, 2015).

Studies have shown that this pattern is further complicated by the major contributing factors for the prevalence of type II diabetes such as obesity, sedentary life style and an unhealthy diet pattern, which have seen an increase in the burden of diabetes and hypertension in urban populations in India (Vigneswari, 2015). Foot complications pose a heavy economic burden and in developing countries it is estimated that foot problems account for 40% of the healthcare resources available (Viswanathan and Rao, 2013).

The semi-urban location of the hospital where the research took place means that it serves large portions of urban Chennai, but is also responsible for around

200 rural villages. The burden of diabetes and its complications, alongside poor awareness levels of healthcare access and available health services has been shown to be higher in low socioeconomic groups in developing countries (Ramachandran et al, 2002). Indeed, this study showed that a total of 100 (44.6%) participants were recorded as unemployed or having unskilled jobs and, therefore, in a low-income group. Previous studies have shown that healthcare services are allocated disproportionately between rural and urban areas (Ramachandran et al 2002; Viswanathan and Rao, 2013; Mahakalkar et al, 2015). Health benefits such as reliable screening services and medication are more widely available to urban populations than those in rural communities (Kaveeshwar, 2014). Further, individuals in rural communities are more likely to ignore the complications or use dangerous and ineffective home remedies which then lead to complications (Viswanathan and Rao, 2013).

Studies from India have shown that the treatment and management of diabetes-related foot complications incurred the highest financial burden, with patients personally spending four times more than patients with no complications (Kumpatla, 2013). Even when foot health services are sought, patients are less likely to adhere to management and foot health education strategies and often due to long travelling distances will not return for follow-up appointments (Viswanathan and Rao, 2013).

The majority of participants in this study were walking barefoot at home and 31 (18%) of these participants had developed ulceration. This perhaps indicates a lack of understanding of the protective role of footwear. Sociocultural practices such as barefoot walking indoors, removal of footwear for religious practices and the use of non-protective and or ill-fitting footwear have been shown to lead to hyperkeratosis, fissures, injuries and wounds (Vijay et al, 2000; Abbas et al 2007; Chandalia, 2008). For those with diabetes and associated neuropathy and/or ischaemia, footwear choices become more important as appropriate footwear still often requires adaptation to accommodate altered foot function and deformities. It has been reported that for people with diabetes, the use of footwear indoors and outdoors will result in less foot problems compared with those who only wear shoes outside (Vijay et al, 2000). Several research studies (Vijay et al, 2000; Bus 2012; Rizzo et al 2012) have suggested a structured approach to appropriate/therapeutic footwear can significantly reduce the incidence of ulceration.

In this study, the most common reason for attending the clinic was pain (41%), ulceration was reported by 16% and the remaining complaints were of minor foot lesions, such as skin and toenail problems. Many of the participants were unaware of the foot complications they had, especially those with complications associated with diabetes. None of the participants had complained of vascular symptoms as a reason for attending the foot clinic. However, on examination, 21% were identified as having vascular issues and were referred for further investigation. Upon further investigation, 87% of referrals were diagnosed with PAD. The risks of previous foot problems, such as history of ulceration, were also poorly reported by participants, with twenty participants being identified as having experienced a previous ulceration that had not been reported or recorded until now. Smoking, hypertension, hyperglycaemia and hyperlipidemia are all factors that are prevalent in the Indian population and contribute to the development of PAD and ulceration (Clayton, 2009; Viswanathan and Rao, 2013; Jyothylekshmy et al, 2015; Mahakalkar et al, 2015; Vigneswari, 2015).

Following physical examination, 275 problems were identified, but only 225 problems had been reported, therefore, 19% of patients had under-reported their foot health problems. The greatest difference was identified in the number of participants reporting heel fissures (7.1%) with an additional 27% being diagnosed following examination. These results highlight their poor knowledge in relation to foot health problems and associated risk factors. A number of patients were diagnosed with PAD and or PN following examination and this was in both those with diabetes and those without.

Other studies (Chandalia et al, 2008; Hasnain and Sheikh, 2009; Chiwanga and Njelekela, 2015) support these findings in that poor knowledge of foot care and poor foot care practices have been identified as important risk factors for foot problems, especially in diabetes. Furthermore, early identification of foot problems and risk factors provides an opportunity for clinicians to educate patients on achievement of foot health.

Results from this study showed that 32% of the participants had a current diabetic ulcer, which is similar to other recent results from the South Indian population (Jyothylekshmy et al, 2015; Mahakalkar et al, 2015). However, this figure could be greater as other studies have shown that a large number of people in this population are unaware its associated complications (Subramani et al, 2014). A total of 93 (42%) participants in this study had diabetes and it is estimated that 10–20% of people with diabetes will have a diabetic foot ulcer at some point in their lives (Department of Health, 2001; NICE, 2015). It can be suggested that the prevalence of ulcerations is set to rise, as India has seen a steady migration of people from rural to urban areas with the economic boom, with corresponding change in lifestyle helping to increase the prevalence of type II diabetes (Kaveeshwar, 2014).

Prevalence is reported to be higher in the south of the country as compared to the northern and eastern parts, with the city of Chennai (where this study was conducted) reporting 13.5% of the population known to have diabetes. (Gupta and Misra, 2007; Kaveeshwar, 2014). However, nationwide data on the prevalence of diabetes and its complications remain unreliable and incomplete due to the lack of large national, multi-centre studies investigating the true status of the disease in such a large and diverse country (Anjana et al, 2011; Kaveeshwar, 2014). Regional studies have shown the prevalence of undiagnosed diabetes in Chennai to be around 9.1%–11.1% (Subramani et al 2014; Mohan et al, 2006) with comparable values elsewhere in the country (10.5%) (Menon et al, 2006). Attendance at the foot clinic may increase the opportunity for focussed screening of foot health for those with and without diabetes and for screening for undiagnosed diabetes.

This study was not without its limitations. Due to the single-centre approach, the data collection occurred in one location and at one point in time and, therefore, no longitudinal data are available. This snapshot does restrict generalisation of the results. For example, the mean age of those with diabetes in this study was 55 years, but research is showing that with rapid urbanisation, migration and lifestyle changes this is set to decrease as the onset of diabetes and its complications occur at a younger age and in those with a lower body mass index (Chan et al, 2009).

Furthermore, a combination of multifactor aetiology of the disease and the heterogeneity of the Indian population means that results extrapolated from specific regions may not be applied accurately to the rest of such a diverse country (Kaveeshwar, 2014). However, the participation in the development of SIFT by those who then subsequently used it does ensure reliability in the results collected at this site as they were trained to use SIFT and the assessment techniques required to complete each section. Hence, it can be extrapolated that the process for a practitioner-focused approach to the development of screening/assessment tool (Harrison-Blount et al, 2014; Harrison-Blount et al, 2015) that meets local needs is transferable, as this can achieve identification of the problems and ownership of the solutions that are needed to bring about change within services and individual clinical practice in India.

In this locality, the late presentation of foot problems is due to the multiple factors of an aging population, poor knowledge of foot care practices, limited access to foot health services, especially for those in low socioeconomic group, poor footwear practices and the growing burden of diabetes. Given the late presentation of foot problems and, hence, the subsequent delay in foot care interventions, it is clear that clinicians need to educate people about the factors known to be associated with foot problems and, in particular, foot ulcers. Targeting those with the risk factors for developing diabetes and those who have diabetes-related complications is crucial for preventing first ulceration (Bus et al, 2008).

For those who have already experienced a foot ulcer, education is vital in relation to preventing lower-extremity amputation and for those already with an amputation, it is essential in order to protect the remaining limb. Aligned with patient education, clinicians need the skills and knowledge to screen the feet for structural abnormalities, reduced joint mobility, tissue viability infections and to assess footwear suitability.

The authors have demonstrated that at a designated clinic, the use of a context-specific tool and clinician training has the potential to aid in the early recognition of foot health problems in those with or without diabetes.

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Conclusion

This study has collected data using a SIFT, to provide an insight into the prevalence of foot health in a single Indian locality. It describes the prevalence of predisposing factors for the development of foot problems, the range and nature of foot health problems and the epidemiology of foot complications, particularly in association with diabetes. It is clear that further health education is required around foot healthcare practices, footwear and the complications associated with diabetes. This should not just be restricted to patients, but also used to guide physicians in the early identification and management of foot health problems. ■

Abbas ZG, Viswanathan V (2007). The diabetic foot in Africa and India. *Int Diab Monit* 19: 8–12

American Diabetes Association (2013). Economic costs of diabetes in the U.S. in 2012. *Diabetes Care* 36(4): 1033–46

Anjana RM, Ali MK, Pradeepa R, et al (2011) The need for obtaining accurate nationwide estimates of diabetes prevalence in India-rationale for a national study on diabetes. *Indian J Med Res* 133 (4): 369

Apelqvist J, Bakker K, Van Houtum WH (1999): *International Consensus on the Diabetic Foot*. John Wiley & Sons, Amsterdam, the Netherlands.

Bower VM, Hobbs M (2009). Validation of the basic foot screening checklist. A population screening tool for identifying foot ulcer risk in people with diabetes mellitus. *J Am Podiatr Med Assoc* 99(4): 339–46

Bus SA, Valk GD, van Deursen RW, Armstrong DG et al (2008). The effectiveness of footwear and offloading interventions to prevent and heal foot ulcers and reduce plantar pressure in diabetes: a systematic review. *Diabetes Metab Res Rev* 24(Suppl 1): S162–S80

Campbell JA (2006). Characteristics of the foot health of "low risk" older people: a principal components analysis of foot health measures. *The Foot* 16(1): 44–50

Chan JN, Malik V, Jia W, et al (2009). Diabetes in Asia: epidemiology, risk factors, and pathophysiology. *JAMA* 301(20): 2129–40

Chandler DJ, Hansen KS, Mahato B et al (2015) Household Costs of Leprosy Reactions (ENL) in Rural India. *Journal of Neglected Tropical Diseases*. Available at: http://dx.doi.org/10.1371/journal.pntd.0003431 (accessed 01.06.2016)

Chandalia HB, Singh D, Lamba PS (2008). Footwear and foot care knowledge as risk factors for foot problems in Indian diabetics. *Int J Diabets Dev Ctries* 28(4): 109–13

Chiwanga FS, Njelekela MA (2015) Diabetic foot: prevalence, knowledge, and foot self-care practices among diabetic patients in Dar es Salaam, Tanzania – a cross-sectional study. *J Foot Ankle Res* 8: 20

Clayton, W (2009). A review of the pathophysiology, classification, and treatment of foot ulcers in diabetic patients. *Clin Diabetes* 27(2): 52–8

Department of Health (2001) *National Service Framework for Diabetes: Standards*. Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/198836/National_Service_Framework_for_Diabetes.pdf. (accessed 01.06.2016)

Gupta R, Misra A (2007). Review: type 2 diabetes in India: regional disparities. *Br J Diabetes Vasc Dis* 7(1): 12–6

Harrison-Blount M, Cullen M, Nester CJ, Williams AE (2014) The assessment and management of diabetes related lower limb problems in India-an action research approach to integrating best practice. *J Foot Ankle Res* 7: 30

Harrison-Blount M, Cullen M, Nester CJ, Williams AE (2015) An action research approach to facilitating the adoption of a foot health assessment tool in India. *J Foot Ankle Res* 8: 52

Hasnain S, Sheikh NH (2009) Knowledge and practices regarding foot care in diabetic patients visiting diabetic clinic in Jinnah Hospital, Lahore. *J Pak Med Assoc* 59(10): 687–90

Hill CL, Gill TK, Menz HB, Taylor AW (2008) Prevalence and correlates of foot pain in a population-based study: the North West Adelaide health study. *J Foot Ankle Res* 1: 2

International Diabetes Federation (2014) *Diabetes Atlas Update Poster* (6th ed.) Brussels: International Diabetes Federation. http://www.idf.org/diabetesatlas. (accessed 01.06.2016).

Jyothylekshmy V, Menon AS, Abraham S (2015) Epidemiology of diabetic foot complications in a podiatry clinic of a tertiary hospital in South India. *Indian J Health Sci* 8: 48–51

Kaveeshwar SA, Cornwall J (2014). The current state of diabetes mellitus in India. *Australas Med J* 7: 45–8

Kumpatla S, Kothandan H, Tharkar S, Viswanathan V (2013) The costs of treating long-term diabetic complications in a developing country: a study from India. *J Assoc Physicians India* 61(2): 102–9

Mahakalkar CC, Kaple MN, Janardhan J et al (2015) Pattern of diabetic foot — presentation and complications in rural Indian population. *International Journal of Research in Medical Sciences* 3(4): 948–53

Mehra BR, Thawait AP, Karandikar SS, et al (2008). Evaluation of foot problems among diabetics in rural population. Indian J Surg. 70:175–80

Menon VU, Kumar A, Gilchrist, TN et al (2006) Prevalence of undetected diabetes and associated risk factors in central Kerala - ADEPS. *Diabetes Res Clin Pract* 74(3): 289–94

Mohan V, Deepa M, Deepa R et al (2006) Secular trends in the prevalence of diabetes and impaired glucose tolerance in urban South India-the Chennai Urban Rural Epidemiology Study (CURES-17). *Diabetologia* 49(6): 1175–8

Mohan V, Shah S, Saboo B (2013) Current glycaemic status and diabetes related complications among type 2 diabetes patients in India: data from the A1chieve study. *J Assoc Physicians India* 61(1 Suppl): 12–5

Morbach S, Lutale JK, Viswanathan V et al (2004) Regional differences in risk factors and clinical presentation of diabetic foot lesions. *Diabet Med* 21(1): 91–5

National Institute for Clinical Excellence (2015) Diabetic foot problems: Prevention and Management of Foot Problems. NICE Guideline 19. Available at: https://www.nice.org.uk/guidance/ng19 (accessed 01.06.16)

Premalatha G, Shanthirani S, Deepa R (2000) Prevalence and risk factors of peripheral vascular disease in a selected South Indian population: the Chennai Urban Population Study. *Diabetes Care* 23(9): 1295–300

Ramachandran A, Snehalatha C, Vijay V, King H (2002) Impact of poverty on the prevalence of diabetes and its complications in urban southern India. Diabet Med 19:130- 135.

Ramachandran A (2004) Specific problems of the diabetic foot in developing countries. *Diabet Metag Res Rev* 20(Suppl 1): S19–S22

Rizzo L, Tedeschi A, Fallani E et al (2012) Custom-made orthosis and shoes in a structured follow-up program reduces the incidence of neuropathic ulcers in high-risk diabetic foot patients. *Int J Low Extrem Wounds* 11(1): 59–64

Shankhdhar K, Shankhdhar L.K, Shankhdhar U, Shankhdhar S (2008) Diabetic foot problems in india: an overview and potential simple approaches in a developing country. *Curr Diab Rep* 8(6): 452-7

Subramani R, Devi U, Shankar U et al (2014) Prevalence of Undiagnosed Type 2 Diabetes and its Associated Risk Factors in Rural Population of Tamil Nadu. *World Journal of Medical Sciences* 11(2): 222–7

Vigneswari A, Manikandan R, Satyavani K, et al (2015) Prevalence of Risk Factors of Diabetes Among Urban Poor South Indian Population. *J Assoc Physicians India* 63(10): 32–4

Vijay V, Seena R, Snehalatha C, Ramachandran A (2000) Routine foot examination: the first step towards prevention of diabetic foot amputation. *Practical Diabetes International* 17(4): 112–4

Viswanathan V, Madhavan S, Rajasekar S, (2005) Amputation prevention initiative in South India: Positive impact of foot care education. *Diabetes Care* 28: 1019–21

Viswanathan V, Rao NV (2013) Managing diabetic foot infection in India. *Int J Low Extrem Wounds* 12: 158–66